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METHOD AND APPARATUS FOR DYNAMICALLY DETERMINING ACTIONS
TO PERFORM FOR AN OBJECT

BACKGROUND OF THE INVENTION

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1.   Technical Field:

The present invention provides an improved data processing system and in particular a method and apparatus for manipulating data. Still more
10   particularly, the present invention provides a method, apparatus, and computer implemented instructions for identifying actions that may be performed for an object.

2.   Description of Related Art:

15   The use of data processing systems has become widespread and pervasive in society. The interface through which a user interacts with a data processing system has advanced from the entry of command line commands to graphical user interfaces (GUIs). A
20   graphical user interface (GUI) is a graphics-based user interface that incorporates icons, pull-down menus and a mouse. The GUI has become the standard way users interact with a computer. The GUI is used to perform actions such as, for example, start programs, terminate programs,
25   communicate with other users at other data processing systems, and data manipulation. These actions are accomplished by the user employing input devices such as, for example, a mouse and a keyboard. Objects representing data and programs may be represented on the
30   GUI using icons. Oftentimes, a list of actions that may be performed on an object are presented to the user in response to some input, such as a selection of a right

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mouse button, pressing a function key on a keyboard, or by moving a pointer over a certain region of the GUI.

The actions that may be performed on an object are numerous. For example, a user may copy, cut, delete,
5 paste, run, export, or move an object. These actions may be presented to the user to allow the user to identify what actions may be taken and to provide an interface to execute a selected action. These actions are commonly presented in a pop-up menu for user selection.
10 Currently, the actions that are presented to the user are predetermined and not easily changed. The actions that are associated with an object are hard coded. Hard coded software is software that is programmed to perform a fixed number of tasks without regard to future
15 flexibility. This type of programming is very easy to perform and is the ideal kind of programming for one-time jobs. Such programs typically use a fixed set of values and may only work with certain types of devices. The problem with these types of programs is that one-time
20 programs often become widely used, even in day-to-day operations, but they are difficult to change because the routines have not been generalized to accept change. Changing actions allowed on an object are difficult and require reinstalling or recompiling a program. The
25 mechanism of the present invention also supports runtime determination of actions against object types when both the object type and related actions are not known at creation of the launching code.

Therefore, it would be advantageous to have an
30 improved method, apparatus, and computer implemented instructions for determining actions that can be performed with an object.

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SUMMARY OF THE INVENTION

5   The present invention provides a method, apparatus, and computer implemented instructions for presenting actions associated with an object displayed in a graphical user interface in a data processing system. Actions are dynamically associated with the object. In

10   response to a selection of the object, the actions are presented in the graphical user interface.

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BRIEF DESCRIPTION OF THE DRAWINGS

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The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in

10 conjunction with the accompanying drawings, wherein:

Figure 1 is a pictorial representation of a data processing system in which the present invention may be implemented in accordance with a preferred embodiment of the present invention;

15 **Figure 2** is a block diagram of a data processing system in which the present invention may be implemented;

Figure 3 is a diagram illustrating components used to dynamically determine actions that can be performed on an object in accordance with a preferred embodiment of

20 the present invention;

Figure 4 is a diagram of a graphical user interface in which actions are presented to a user in accordance with a preferred embodiment of the present invention;

Figure 5 is a flowchart of a process used for

25 registering actions in accordance with a preferred embodiment of the present invention;

Figure 6 is a flowchart of a process used for adding menu items for a Java class in accordance with a preferred embodiment of the present invention;

30 **Figure 7** is a flowchart of a process used for populating a collection for a pop-up menu in accordance with a preferred embodiment of the present invention; and

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Figure 8 is a flowchart of a process used for executing an action in accordance with a preferred embodiment of the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures and in particular
5   with reference to **Figure 1**, a pictorial representation of
a data processing system in which the present invention
may be implemented is depicted in accordance with a
preferred embodiment of the present invention.   A
computer **100** is depicted which includes system unit **102**,
10   video display terminal **104**, keyboard **106**, storage devices
108, which may include floppy drives and other types of
permanent and removable storage media, and mouse **110**.
Additional input devices may be included with personal
computer **100**, such as, for example, a joystick, touchpad,
15   touch screen, trackball, microphone, and the like.
Computer **100** can be implemented using any suitable
computer, such as an IBM eServer pSeries computer or
IntelliStation computer, which are products of
International Business Machines Corporation, located in
20   Armonk, New York. Although the depicted representation
shows a computer, other embodiments of the present
invention may be implemented in other types of data
processing systems, such as a network computer. Computer
100 also preferably includes a graphical user interface
25   (GUI) that may be implemented by means of systems
software residing in computer readable media in operation
within computer **100**.

With reference now to **Figure 2**, a block diagram of a
data processing system is shown in which the present
30   invention may be implemented. Data processing system **200**
is an example of a computer, such as computer **100** in

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Figure 1, in which code or instructions implementing the processes of the present invention may be located. Data processing system **200** employs a peripheral component interconnect (PCI) local bus architecture. Although the
5   depicted example employs a PCI bus, other bus architectures such as Accelerated Graphics Port (AGP) and Industry Standard Architecture (ISA) may be used. Processor **202** and main memory **204** are connected to PCI local bus **206** through PCI bridge **208**. PCI bridge **208** also
10   may include an integrated memory controller and cache memory for processor **202**. Additional connections to PCI local bus **206** may be made through direct component interconnection or through add-in boards. In the depicted example, local area network (LAN) adapter **210**, small
15   computer system interface (SCSI) host bus adapter **212**, and expansion bus interface **214** are connected to PCI local bus **206** by direct component connection. In contrast, audio adapter **216**, graphics adapter **218**, and audio/video adapter **219** are connected to PCI local bus **206** by add-in boards
20   inserted into expansion slots. Expansion bus interface **214** provides a connection for a keyboard and mouse adapter **220**, modem **222**, and additional memory **224**. SCSI host bus adapter **212** provides a connection for hard disk drive **226**, tape drive **228**, and CD-ROM drive **230**. Typical PCI local
25   bus implementations will support three or four PCI expansion slots or add-in connectors.

An operating system runs on processor **202** and is used to coordinate and provide control of various components within data processing system **200** in **Figure 2**. The
30   operating system may be a commercially available operating system such as Windows 2000, which is available from

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Microsoft Corporation. An object oriented programming
system such as Java may run in conjunction with the
operating system and provides calls to the operating
system from Java programs or applications executing on
5   data processing system **200**. "Java" is a trademark of Sun
Microsystems, Inc. Instructions for the operating system,
the object-oriented programming system, and applications
or programs are located on storage devices, such as hard
disk drive **226**, and may be loaded into main memory **204** for
10   execution by processor **202.**

     Those of ordinary skill in the art will appreciate
that the hardware in **Figure 2** may vary depending on the
implementation. Other internal hardware or peripheral
devices, such as flash ROM (or equivalent nonvolatile
15   memory) or optical disk drives and the like, may be used
in addition to or in place of the hardware depicted in
Figure 2. Also, the processes of the present invention
may be applied to a multiprocessor data processing
system.

20   For example, data processing system **200**, if
optionally configured as a network computer, may not
include SCSI host bus adapter **212**, hard disk drive **226**,
tape drive **228**, and CD-ROM **230**, as noted by dotted line
232 in **Figure 2** denoting optional inclusion. In that
25   case, the computer, to be properly called a client
computer, must include some type of network communication
interface, such as LAN adapter **210**, modem **222**, or the
like. As another example, data processing system **200** may
be a stand-alone system configured to be bootable without
30   relying on some type of network communication interface,
whether or not data processing system **200** comprises some
type of network communication interface. As a further

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example, data processing system **200** may be a personal digital assistant (PDA), which is configured with ROM and/or flash ROM to provide nonvolatile memory for storing operating system files and/or user-generated

5   data.

The depicted example in **Figure 2** and above-described examples are not meant to imply architectural limitations. For example, data processing system **200** also may be a notebook computer or hand held computer in

10   addition to taking the form of a PDA. Data processing system **200** also may be a kiosk or a Web appliance. The processes of the present invention are performed by processor **202** using computer implemented instructions, which may be located in a memory such as, for example,

15   main memory **204**, memory **224**, or in one or more peripheral devices **226-230**.

The present invention provides a method, apparatus, and computer implemented instructions for dynamically determining actions that are to be associated with an

20   object. The mechanism of the present invention involves non hard-coded software, which is data independent with respect to the mappings of actions and their associations or mappings to objects. This type of software is written such that any data that can possibly be changed should be

25   stored in a database and not "hard wired" into the code of the program. When values change or are added only the database item is altered, which is a simple task, rather than recompiling programs.

In these examples, the mechanism is implemented in

30   the Java programming language. Mappings between actions to perform and an object's class type identify a set of allowable actions for a given object. This determination

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may be made at runtime. This mechanism allows existing
relationships or associations of actions and objects to
be determined at runtime based on the saved class type to
actions' mappings. Examples of object types include
5   security objects, such as roles, accounts, capabilities,
principals, and persons. Other objects types may be, for
example, Java Naming Directory Interface (JNDI) objects,
such as javax.naming.Context (a folder) and
javax.naming.directory.DirContext (a folder with
10   attributes). These object types also may include an IP
address, an IP node, and a gateway.

Turning next to **Figure 3**, a diagram illustrating
components used to dynamically determine actions that can
be performed on an object is depicted in accordance with
15   a preferred embodiment of the present invention. The
components illustrated in **Figure 3** may be found in a data
processing system, such as, for example, data processing
system **200** in **Figure 2**.

Classes **300** are classes for objects presented in GUI
20   **302**. Menu process **304** provides a mechanism to generate
menus of actions that can be performed on objects. Menu
process **304** receives classes **300** and dynamically
determines which actions should be associated in
preparation for displaying a pop-up menu. In these
25   examples, menus are the form in which the actions are
presented to a user. These examples are not meant to
limit the fashion in which actions associated with
objects can be presented. These associations are
determined at runtime or at the time the program is
30   executed in these examples. In this manner, actions may
be added and removed from associations with objects such
that the effects of these changes are presented to the

user at runtime. An example of this mapping is a file
system directory, which can have multiple actions related
to it. Examples of these multiple actions are cut, copy,
paste, rename, delete, create subdirectory, and view. A
5   file system item such as a bat file has a different set
of related actions even though some are common with the
directory above. Some examples are cut, copy, rename,
delete, and execute. In this example, the actions paste,
create subdirectory and view are not applicable to a
10 non-folder. But a new action of execute also has been
added since a bat file is executable.

     With reference now to **Figure 4**, diagram of a
graphical user interface in which actions are presented
to a user is depicted in accordance with a preferred
15 embodiment of the present invention. Window **400** is an
example of a window that may be presented in a GUI, such
as GUI **302** in **Figure 3**.

     In this example, window **400** is an interface for a
file navigation program used to manipulate files and
20 folders or directories in a file system. Window **400**
shows a tree of folders in section **402**. The folders are
nodes in which the nodes are presented as folder icons,
404, **406**, **408**, and **410**. Section **412** in window **400**
illustrates the contents of folder **408**. Pop-up window
25 **414** shows actions that may be performed on folder **408**.
These actions include "Copy" **416**, "Create Subdirectory"
418, "Cut" **420**, "Remove" **422**, "Rename" **424**, "Select All"
426, "Select None" **428**, and "View Directory" **430**.   In
this example, these actions are identified dynamically at
30 the time the program that presents the actions started.
The time when this program starts is also referred to as
"runtime". In other words, actions associated with

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folder **408** may be changed and the change will be
reflected the next time the program is started.
Depending on the implementation, some actions may be
hard-coded while others are dynamically determined. The

5   two are combined to make the final pop-up menu. Examples
of hard-coded actions in the file system are rename and
remove. Examples of dynamically-determined actions are
create subdirectory, view, and execute.

Figures 5-8 below illustrate processes used to

10 dynamically identify actions associated with objects and
generate a presentation of these actions. The flowcharts
in **Figures 5-8** are presented for an implementation of the
present invention in the Java programming language. With
reference now to **Figure 5**, a flowchart of a process used

15 for registering actions is depicted in accordance with a
preferred embodiment of the present invention.   The
process illustrated in **Figure 5** occurs prior to runtime
of a program in a registration phase. The source of the
registered material may be, for example, XML, a GUI, or a

20 command line. In these examples, the process in **Figure 5**
stores data registering a Java class and its associated
actions in a data structure, such as a database or a flat
file on a file system.

The process begins with a determination as to

25 whether an unprocessed fully-qualified Java class, which
can have an action, is present (step **500**). A fully
qualified Java class name includes the Java package in
which it resides as a prefix. Most Java classes reside
in packages to ensure that there is no name collision

30 between two classes produced by two different companies,
divisions, etc. For instance, the Java language has a
standard class named "String". The fully-qualified class

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name is java.lang.String. When storing the String class
name, the fully-qualified java.lang.String is stored
because there also could be a com.foo.String class. This
action avoids confusing the two when determining related

5   actions at runtime. The qualifiers are not mandatory,
but product-level code typically uses package qualifiers
to ensure that no collision of the class names occurs
across companies, products, etc. So, the package
qualification of a Java class is an intrinsic part of

10   its name. An action is a separately-related object in
its own right. If an unprocessed Java class is present
in which the Java class can have an action, the
unprocessed Java class is selected (step **502**). The
string version of the fully-qualified Java class that has

15   related actions is saved (step **504**). In the case of the
Java String class, "java.lang.String" is saved in the
data structure. This string version of the class is
later used in step **700** in **Figure 7** as a lookup mechanism
for related actions.

20   Next, a determination is made as to whether an
unprocessed action, which can be launched relative to the
Java class, is present (step **506**). If an unprocessed
action is absent, the process returns to step **500** as
described above to determine whether additional

25   unprocessed Java class are present. Otherwise, the
ResourceBundle class name and key is saved for the action
text (step **508**). A ResourceBundle is Java's way of
providing internationalized, separately-provided text for
a Java program. The ResourceBundle includes a key for a

30   string and then its value. In the case of an action, an
actual example is a key of "CREATE_SUBDIR" with an
English value of "Create Subdirectory", a Spanish value

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of "Crear subdirectorio" and an Italian value of "Crea
sottodirectory". Depending on the language used at
execution of the program, the user would see the
appropriate text for their language for the create

5   subdirectory action. The fully-qualified Java class is
saved for the action (step **510**) with the process
returning to step **506**. The fully-qualified class name of
the Java class is saved in the data structure. That name
is later used at runtime as a key for related actions to

10 that Java class. In order to get the fully-qualified
string class name for any Java object, you can do the
following:

AnyJavaObject.getClass().getName()

15

For instance, if you ask a Java Object of type String for
its class(via someStringJavaObject.getClass().getName()),
"java.lang.String" will be returned.

With reference now to **Figure 6**, a flowchart of a

20 process used for adding menu items for a Java class is
depicted in accordance with a preferred embodiment of the
present invention. The process illustrated in **Figure 6**
may be implemented in a menu process, such as menu
process **304** in **Figure 3**.

25   The process begins by passing a Java object in from
an application from a source (step **600**). This source may
be, for example, an explorer, a tree, or a table. Next,
an empty collection for pop-up menu items is created
(step **602**). This collection also is referred to as a

30 pop-up menu items collection. Then, the Java object's
class is retrieved (step **604**). Actions are added to the
pop-up menu items collection for the Java class (step

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606). Step **606** is described in more detail in **Figure 7**
below. A pop-up menu is created from the pop-up menu
item collection (step **608**). This step includes
registering ActionListeners for each pop-up menu item and
5 recording the actionCommand as the Java class needed to
perform the related action. The pop-up menu is displayed
(step **610**) and the process terminates.

Turning next to **Figure 7**, a flowchart of a process
used for populating a collection for a pop-up menu is
10 depicted in accordance with a preferred embodiment of the
present invention. The process illustrated in **Figure 7**
may be implemented in a menu process, such as menu
process **304** in **Figure 3**. This process is used to store
action information in a collection and may call itself in
15 a recursive fashion.

The process begins by retrieving related actions for
the string name for the Java class (step **700**). In these
examples, the related actions are retrieved from a
database or a flat file. The actions are stored using
20 information generated by registration of classes as
illustrated in **Figure 5** above. These actions are in the
form of action definitions in this example. Next, a
determination is made as to whether an unprocessed action
definition is present (step **702**). If unprocessed action
25 definitions are present, an unprocessed action definition
is selected for processing (step **704**). The text for the
action is looked up using a ResourceBundle and a key for
the registered action using standard Java logic (step
706). A string name for the Java class for the action is
30 retrieved from the registered information (step **708**).
Then, the action text and the Java class string name are
saved in the collection (step **710**) with the process then

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returning to step **702** as described above. The collection
is the pop-up menu items collection discussed in **Figure 6**
above.

Turning back to step **702**, if unprocessed action
5   definitions are not present, all of the action
definitions for the Java class have been processed. At
this point, a determination is made as to whether an
unprocessed Java superclass is present for this Java
class (step **712**). A superclass is a parent class to a
10   class. If an unprocessed Java superclass in present,
this superclass is selected for processing (step **714**).
Pop-up menu items are added for this Java superclass
(step **716**) with the process then returning to step **712** as
described above. Step **716** is a recursive call to the
15   process in **Figure 7** for the Java superclass.

With reference again to step **712**, if unprocessed
Java superclasses are absent, a determination is made as
to whether an unprocessed interface implemented by the
Java class is present (step **718**). An interface, as used
20   with respect to the description of **Figure 7**, defines a
set of methods and constants to be implemented by another
object. If an unprocessed interface implemented by the
Java class is present, the unprocessed interface is
selected for processing (step **720**). Pop-up menu items
25   for this interface are added by recursively calling the
process in **Figure 7** (step **722**) with the process then
returning to step **718**. Otherwise, the process
terminates. In steps **716** and **722**, the recursive call
initiates the process in **Figure 7**. The actions
30   retrieved, however, are for the superclass or the
interface rather than the original Java class when the

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process in **Figure 7** is first called.

　　　　With reference now to **Figure 8**, a flowchart of a
process used for executing an action is depicted in
accordance with a preferred embodiment of the present

5　invention. The process illustrated in **Figure 8** may be
implemented in a menu process, such as menu process **304**
in **Figure 3**. The process in **Figure 8** is in response to a
user selecting a pop-up menu item causing an
actionPerformed method to be called. This process

10　results in an ActionEvent object being passed in the
callback. Java provides an interface which can be
implemented to handle callbacks on menu item selection,
button presses, etc. This interface is called the
ActionListener interface. The fully-qualified name is

15　java.awt.event.ActionListener. The one method in this
interface is the actionPerformed method which receives an
input parameter of type java.awt.event.ActionEvent. This
ActionEvent object has the method getActionCommand, which
returns a string for the menu item which is triggering

20　the callback. In the present invention, when the
actionPerformed callback is invoked, the code
interrogates the ActionEvent object (via the
getActionCommand method) to determine which pop-up menu
item has been selected. Then, the user's selected action

25　can be instantiated and executed. The object contains the
string name of the Java class saved in the process
described in **Figure 6** above.

　　　　In **Figure 8**, the process begins by retrieving the
actionCommand for an action from the ActionEvent object

30　passed in response to a selection of an action from menu
item (step **800**). The object, in this example, is a
string version of the Java class as saved by the process

described in **Figure 6** above. The action class is instantiated based on the actionCommand passing the object of the pop-up to the new action class (step **802**). Then, the action class is executed (step **804**) with the

5   process terminating thereafter. This action class performs the process or logic to execute the action selected by the user. The mechanism of the present invention may be implemented in other programming environments, such as C++. In the C++ environment, the

10   process of the present invention may be performed using C++ Runtime-type identification (RTTI) to determine the class type and then use that type to find the related actions. Generally, if a type for an object can be obtained, the related actions for the object can be

15   looked up.

       Thus, the present invention provides an improved method, apparatus, and computer implemented instructions for identifying actions that may be performed by or on an object. This identification is a dynamic identification

20   in which the association of the actions with an object may be different and dynamically presented at runtime. The menu logic of the present invention can dynamically determine differing menu items at runtime based on registered class-to-action relationships, but the

25   registration of the items related to Java classes is performed prior to runtime. This mechanism allows associating actions with objects without requiring a hard-coded relationship. In this manner, new actions may be associated or existing actions may be unassociated

30   with an object as needed. The present invention provides for extensibility, which allows the behavior of a running program to be extended without redesigning, reworking or

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recompiling the program. Dynamic, runtime determination of a Java class to its related actions provides for extensibility. Hardcoded relationships between a Java class and its actions are undesirable because these types

5   of relationships remove extensibility. The mechanism of the present invention reduces the need for using hardcoded relationships. Further, the mechanism provides a common interface for presenting actions to a user in which only the underlying associations between actions

10   and objects change.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of

15   the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the

20   distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications

25   links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

30   The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the

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invention in the form disclosed. Many modifications and
variations will be apparent to those of ordinary skill in
the art. Although the examples are discussed with
respect to the Java programming language, the mechanism

5 of the present invention may be implemented in other
programming languages, such as, for example, C. Also,
the associations in these examples are identified at
runtime. The embodiment was chosen and described in
order to best explain the principles of the invention,

10 the practical application, and to enable others of
ordinary skill in the art to understand the invention for
various embodiments with various modifications as are
suited to the particular use contemplated.